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Causes and Prevention

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CHAPTER 3

Trends in Lung Cancer Incidence and Mortality in the United States

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ABSTRACT

Increases observed in lung cancer incidence and mortality rates exceed those of any other primary cancer site. Among white males, incidence rates increased more than 200% from the late 1940s to the late 1970s; the corresponding increase among white females was greater than 250%. Rates continue to increase among the older age groups, among the younger groups, the rates of increase are diminishing and some decreases are apparent among males. Rates among nonwhite males, which were lower than those among white males in the past and about equal in the early 1960s, are now substantially higher than those among white males. Geographic patterns have changed over time among white males, as rates in the south have increased more rapidly than in other areas of the country. Lung cancer mortality rates among males were about 30% higher in New Orleans compared to the rest of the country, and incidence rates were the highest of ten reporting areas during the mid-1970s.

Key Words: Lung neoplasms, incidence, mortality, mesothelioma

Introduction

The number of deaths in the United States attributed to lung cancer increased from 18,000 in 1950 to 99,000 in 1979, and it is estimated that there will be 117,000 lung cancer deaths during 1983 (Table 1) (1-3). This is more than a sixfold increase during the 33 years. The number of lung cancer deaths among males has been greater than among females at each point in time: in 1950 the male-female ratio was 4.4 and in 1983 it is projected to be 2.4. Whereas there has been a fivefold increase among males, there has been a tenfold increase among

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Table 1. Impact of lung cancer[a] in the United States from 1950 to 1983[b]

	Total	Males	Females
Number of deaths			
1950	18,313	14,922	3,391
1960	36,420	31,257	5,163
1970	65,454	53,005	12,449
1979	99,059	73,243	25,816
1983 (estimate)	117,000	83,000	34,000
Number of newly diagnosed cases			
1983 (estimate)	135,000	94,000	41,000

[a]Lung, bronchus, trachea, pleura
[b]Source: Refs (1)-(3)

females. It is estimated that 135,000 cases will be diagnosed during 1983, with about 94,000 occurring among males and 41,000 among females. These increases result from several factors: increases in the size of the population, changes in the age distribution of the population, with increasing proportions in the older age groups which are at higher risk of developing cancer, and increases in the rate of occurrence of lung cancer. The purpose of this report is to present the secular trends in rates of lung cancer incidence and mortality and to consider the variations by sex, race, age group, and geographic area.

Materials and Methods

Although mortality data are available for the entire country, corresponding incidence data, which indicate newly diagnosed cases rather than deaths, are not. The U.S. National Cancer Institute (NCI) has supported several surveys of cancer incidence in selected areas of the country: the first in 1937, the second in 1947 (4), a special survey in Iowa in 1950 (5), and the Third National Cancer Survey (TNCS) in 1969–1971 (6). Since 1973, the NCI-sponsored Surveillance, Epidemiology, and End Results (SEER) program has gathered information regarding cancer incidence, mortality, and survival; the participating population-based registries, which now include five states and four cities, provide information pertaining to more than 10% of the entire United States population (7). However, the same geographic areas were not included in each of the surveys or programs. Finally, the state of Connecticut has supported a tumor registry for many years, and this registry is now a participant in the SEER program (8). The original data from the first survey are not available; the current analysis therefore commences with the late 1940s. Drawing on the above-mentioned sources, we have compiled incidence trend data for five geographic areas (5GA): Atlanta, Detroit, San Francisco-Oakland, Iowa, and Connecticut. The populations in these five areas represented between 6 and 7% of the United States population at each time considered and currently represent about 72% of the SEER population.

All rates are average annual rates per 100,000 population. The 1970 United States population distribution was used as the standard for age adjustment. Incidence trends pertain to a composite of the years 1947–1950, the 3 years 1969–1971 (TNCS), and then 2-year averages from 1975–1976 through 1979–1980 (SEER). Corresponding mortality data are 5-year averages from 1950–1954 through 1965–1969, 1970–1975, and then 2-year averages corresponding to the incidence data for 1975–1976 and 1977–1978, and finally 1979 (1980 mortality data are not yet available).

Mortality trends are shown both for the entire United States and for the same five geographic areas for which incidence trends are presented. The cohort mortality curves are based on every fifth year's rates from 1950 to 1975. Mortality trends by race and sex utilize 5-year average annual rates from 1950–1954 through 1975–1979. The coding of race was not as specific in the earlier incidence reporting as it is currently, so most of the data presented pertain only to whites.

Only invasive malignancies are included; in situ tumors of this site are very rare—less than one per 100,000 per year—and are not included. As malignancies arising in the pleura, lung, and bronchus were not distinguished in the earlier coding systems, pleura is included with lung in all considerations of trends. In addition, those of the trachea, pulmonary, and lung, not specified as secondary, are included in the mortality data. The classification of mesotheliomas not specified as malignant has changed over time: they were reportable but not considered malignant during the TNCS, not reportable during the early SEER years, and since 1977 have been reportable and considered malignant; they are included in the mesothelioma rates for 1969–1971.

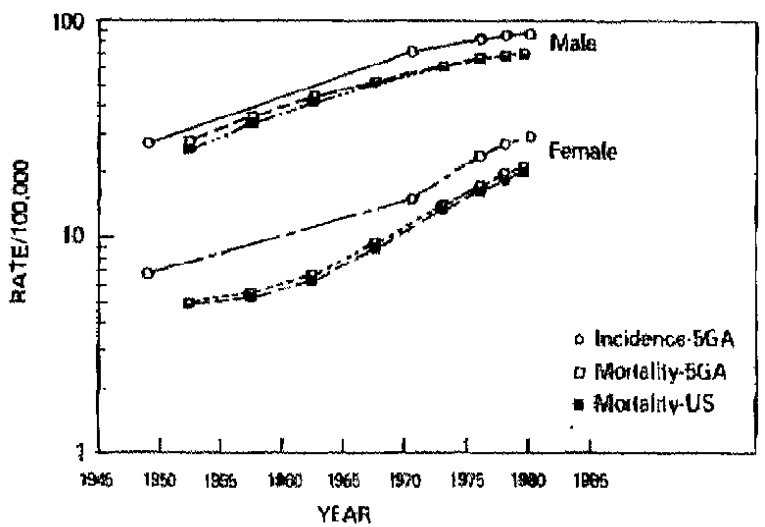

Figure 1. Incidence and mortality trends for lung cancer among whites

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Results

The increases in incidence of lung cancer among white males residing in these 5GA are larger than for any other primary site. The average annual age-adjusted rate increased from 27 to 85 per 100,000 over the 30-year period from the late 1940s to the late 1970s (Figure 1); this was an increase of more than 200%, or 3.5-4% per year. In the past, the lung cancer mortality was slightly higher among white males in the 5GA than in the country as a whole; since the mid-1960s the rates have been quite similar. In recent years there appears to be a change in slope or a decrease in the rate of increase in both incidence and mortality rates.

The increases in incidence of lung cancer among white females also are larger than those for any other primary site. Although the rates are considerably lower than those among males, the proportional increases are larger, more than 250% during the 30 years or about 5% per year. Although we do not have data, the in-

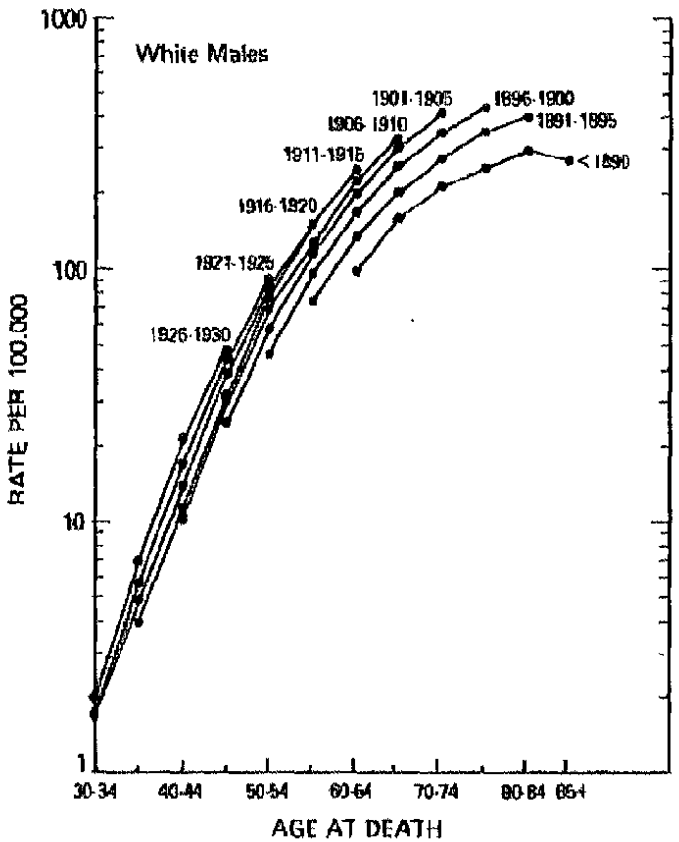

Figure 2. Age-specific United States lung cancer death rates among white males by birth cohort.

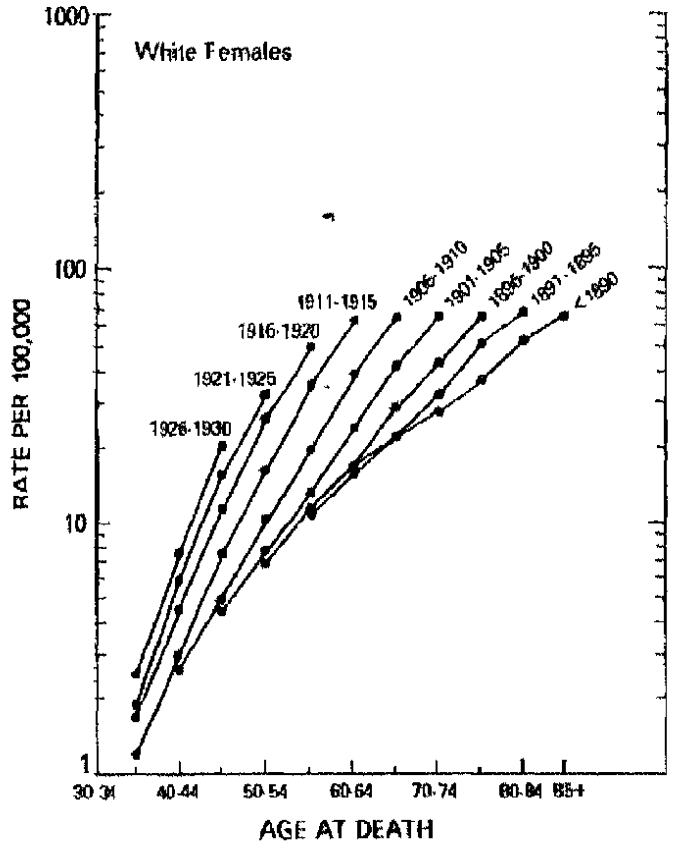

Figure 3. Age-specific United States lung cancer death rates among white females by birth cohort

cidence curve probably paralleled the mortality curve between the late 1940s and 1969-1971. The increases among females have occurred primarily since the early 1960s; this is considerably later than among males. The mortality rates for the 5GA have been only slightly higher than those for the entire United States at each point in time, and the shapes of the curves are quite similar. There appears to be some moderation in the rate of increase in the late 1970s.

Each successive birth cohort of white males has experienced higher lung cancer death rates through 1975 than the preceding cohort (Figure 2). The rates increase exponentially with age, and it is not clear whether there is a peak in risk prior to the oldest age category. Proportional increases were greater in the earlier compared to later cohorts. The rates also increase exponentially with age among birth cohorts of white females (Figure 3), and there is little evidence of a change in slope with increasing age. Although the rates are much lower, the proportional increases between cohorts are greater among females than among males.

There is variation in the incidence trends by age. Among white males (Figure 4), there has been a very recent downturn for those aged 25-34, although the rates are

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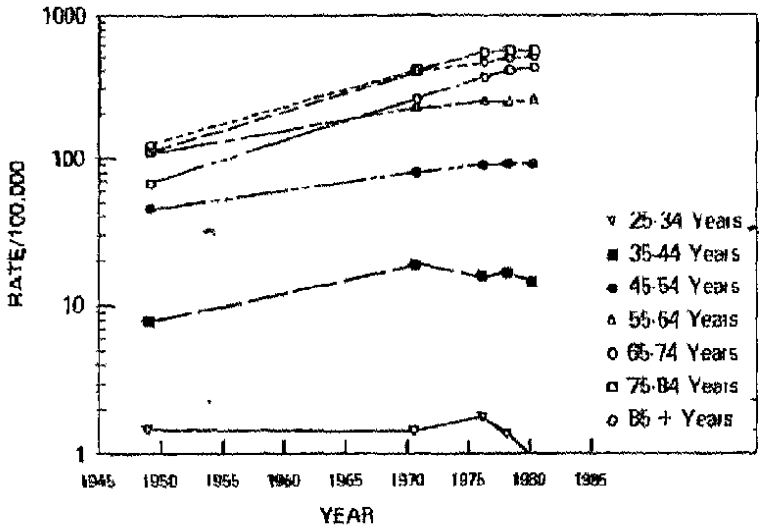

Figure 4. Age-specific incidence trends in five geographic areas for lung cancer among white males

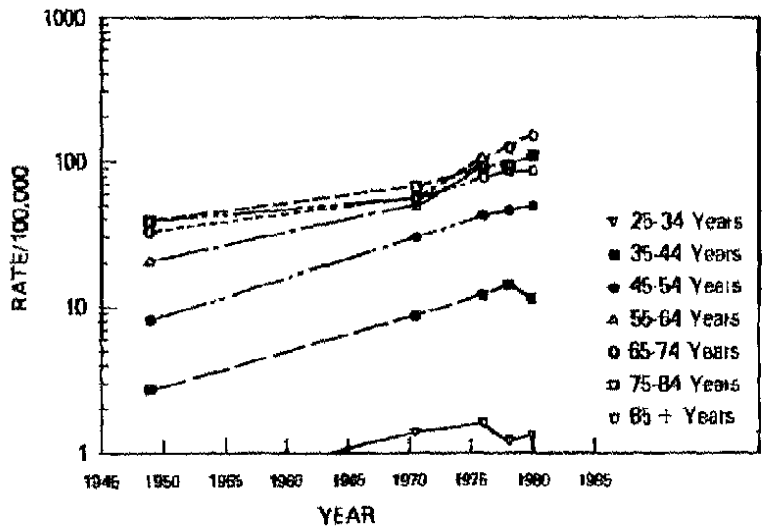

Figure 5. Age-specific incidence trends in five geographic areas for lung cancer among white females

based on small numbers of cases; the rate for 1979-1980 was 0.95 (not zero). Among those aged 35-44, increases were apparent from the late 1940s to 1969-1971, and decreases have occurred since then. Incidence increased in all the other age groups, with the largest proportional increases occurring among those

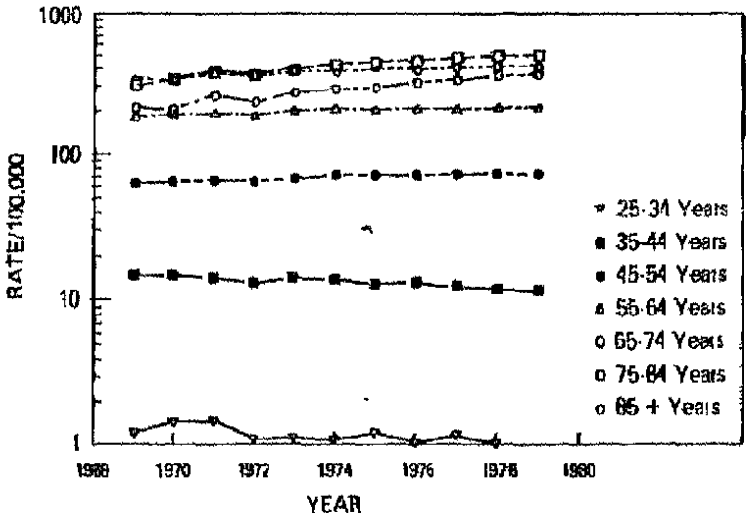

Figure 6. Age-specific United States lung cancer mortality trends among white males

aged 65 and over. Each of the age groups 45 and older shows moderating increases during the 1970s. In contrast, increases prior to 1970 among white females were more pronounced among those under age 65 than those over age 65 (Figure 5). Since then, the largest increases have been among those aged 65-74. There is some suggestion that the rates may be turning downward among females aged 25-44, although the number of cases is relatively low, particularly under age 35.

In the country as a whole, recent mortality data indicate some downturn in rates among white males aged 35-44 (9); over the period from 1969 to 1979 (Figure 6),

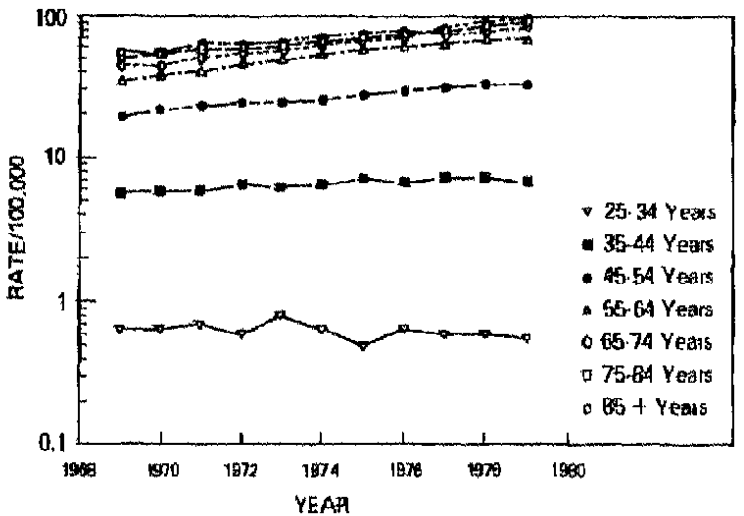

Figure 7. Age-specific United States lung cancer mortality trends among white females

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rates decreased from about 15 to 12 per 100,000 per year. Mortality rates among those aged 45-54 have been fairly stable since 1974, whereas rates among the older age groups continue to increase. Among white females, decreases are suggested only among the very youngest group (under age 35) (Figure 7) (the vertical scale for this figure is different from that used for males to better show the trends). The age group 35-44 shows increases during the early part of the decade, with some indication of leveling off during the latter half of the 1970s. Mortality rates are continuing to increase among all age groups 45 and older.

It has been noted for some time that there is geographic variation in the occurrence of cancer (10). In addition, the patterns have changed over time (11). During the 1950s, the rates were highest in scattered areas around the country, particularly in the northeast and the urban areas. The lung cancer mortality rates were also elevated in a number of Louisiana parishes. Mortality patterns had shifted by 1970-1975, with many of the counties in the southeast having relatively high rates and the rest of the country showing much less variation as urban-rural differences diminished.

The available incidence data support the mortality patterns. The lung cancer rate for Atlanta white males was relatively low in the past (Figure 8) and subsequently has become one of the highest. Increases are apparent in each of the geograpic areas, although increases in Iowa occurred later than in the other areas. Regional differences appear to be diminishing. There is a general change in slope during the 1970s decade.

The incidence rate among white males in New Orleans was higher during the late 1940s than in any other area shown; it was also the highest of the ten cities included in the early survey (4). The New Orleans rate also was high during the

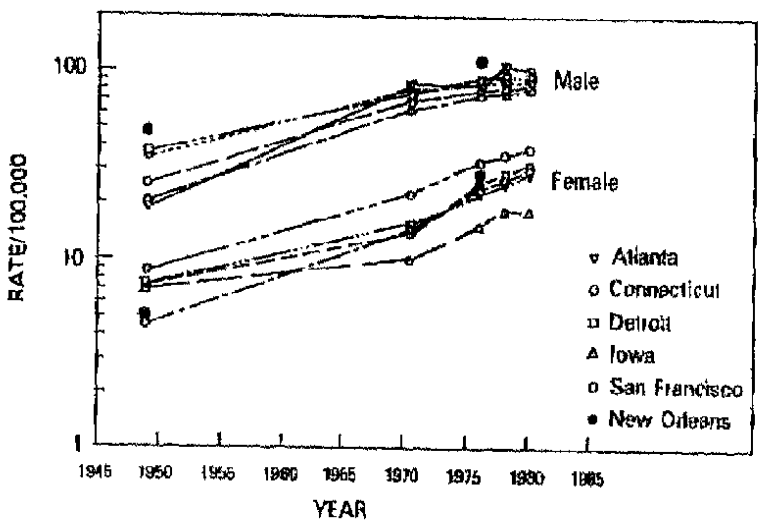

Figure 8. Area-specific incidence trends for lung cancer among whites

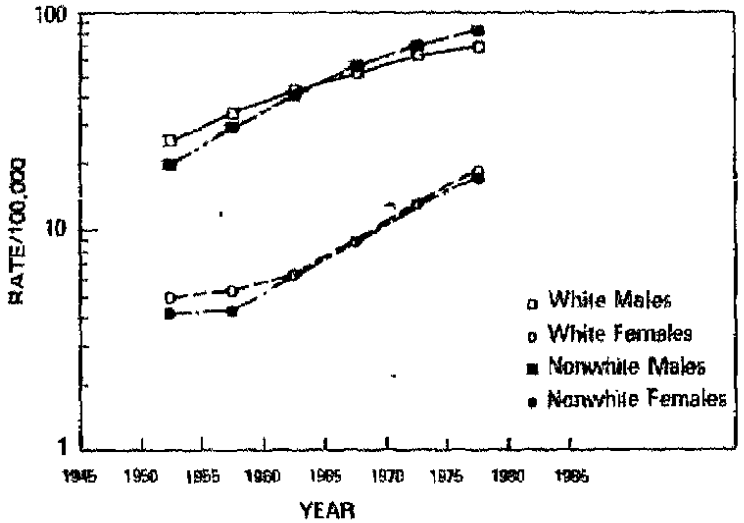

Figure 9. Mortality trends of lung cancer in the United States by race and sex.

1970s. The patterns among white females are somewhat different. The rate in New Orleans was relatively low during the late 1940s and somewhat high during the mid-1970s; the rates in San Francisco-Oakland have been consistently higher than in the other areas; the rate in Iowa showed only small increases from 1950 to 1969-1971, and since then it has increased substantially.

In the early 1950s, lung cancer mortality rates in the total United States were 15-20% lower among nonwhites than among whites of the same sex (Figure 9). By the early 1960s, the rates were quite comparable; rates among females have risen similarly since then. Mortality rates among nonwhite males have continued to rise faster than among white males such that the rate was 18% higher by the late 1970s. The mortality curve, however, does appear to be rising less steeply in recent years. Over the 25-year period shown in Figure 9, the mortality increases among both male and female nonwhites are almost fourfold.

During more recent years, data are available not only for the more diverse group of nonwhites but also specifically for blacks. Between 1969 and 1979, lung cancer mortality rates among black males have increased in all age groups over 55 (Figure 10). Among those aged 45-54, increases were apparent until the late 1970s. Rates among the 35-44 year age group are relatively stable, whereas those for the 25-34 age group suggest some decline. The age-specific mortality trends among black females have been somewhat similar, with larger increases among the older compared to the younger age groups.

There is geographic variation in the lung cancer incidence rates among black as well as white males in the areas participating in the SEER program (Figure 11) (7). The rate for all areas combined was 44% higher among black males than white males (110.0 versus 76.4 per 100,000 per year, respectively). The average annual

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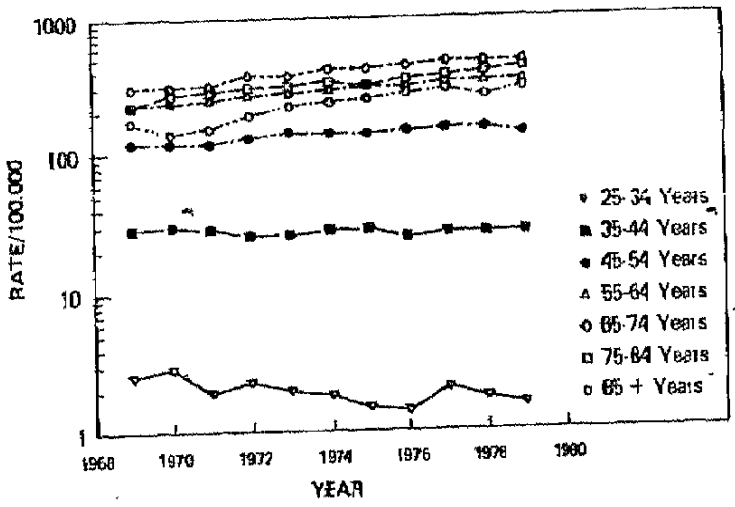

Figure 10. Age-specific United States lung cancer mortality trends among black males

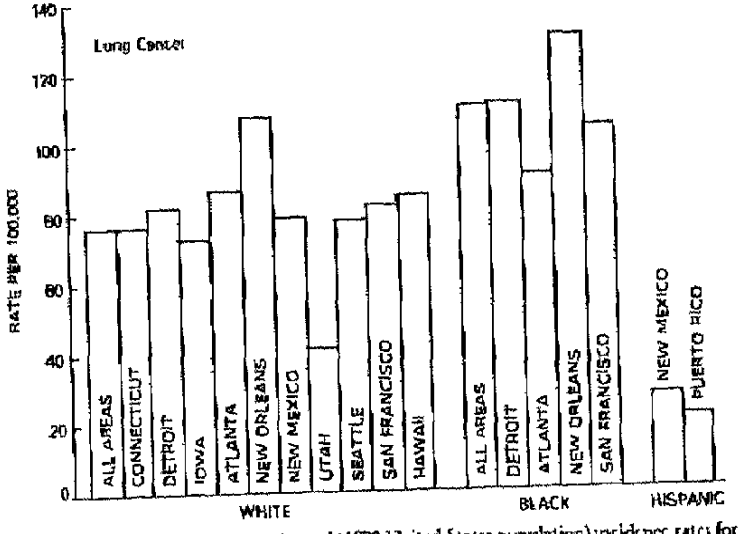

Figure 11. Average annual age-adjusted (1970 United States population) incidence rates for males by race and registry, SEER program, 1973-1977. Courtesy Dr John L. Young, Jr, NCI.

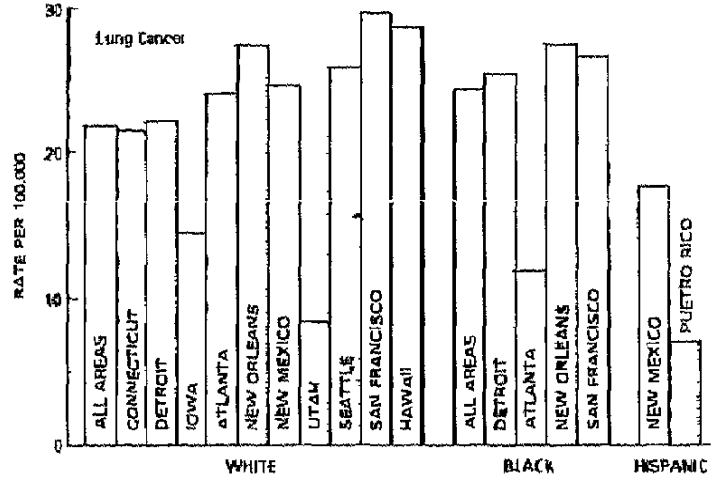

Figure 12. Average annual age-adjusted (1970 United States population) incidence rates for females by race and registry, SEER program, 1973-77. Courtesy Dr John L. Young, Jr, NCI

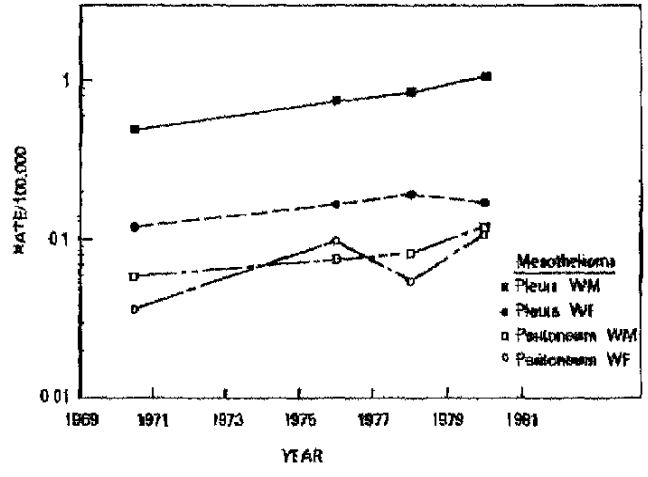

Figure 13. Incidence trends in five geographic areas for mesothelioma among white males and females

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rate for 1973-1977 was highest in New Orleans in both races. The second highest rate among white males was in Atlanta. However, Atlanta black males do not appear to share the excess risk observed among blacks in the other areas. Incidence rates are particularly low among white males in Utah and among Hispanic males in New Mexico and Puerto Rico. Lung cancer incidence among black females is only 11% higher than among white females (24.3 versus 21.8/100,000) (Figure 12). (The scale for this figure also is different from that used for males to better show the patterns.) There is considerable geographic variation within each race. Among white females, rates are relatively high in San Francisco, Hawaii, and New Orleans and relatively low in Iowa and Utah. Among black females, the rate is relatively high in New Orleans and particularly low in Atlanta.

Mesothelioma is a rare type of tumor, accounting for less than 1% of all lung/pleural cancers (7). However, the trends in mesothelioma incidence are of particular interest because of the association between this cancer and asbestos exposure (12). There are difficulties in compiling comparable data because medical diagnosis, terminology, reporting rules, and coding schemes have changed over time. As a result, it is not clear how much of the observed increase in mesothelioma of the pleura from 1969-1971 to 1979-1980 among white males is real and how much is artifact (Figure 13; note that the scale for this figure is 1/100 that of earlier figures). Reported rates among white females are considerably lower than among white males. Mesothelioma also occurs in other sites, primarily the peritoneum; incidence rates for the peritoneum are quite low and are similar for males and females.

Discussion

Large increases have occurred in lung cancer over the past 30 years among both males and females. These increases have affected all age groups and are continuing in the older groups, but there is some suggestion that rates among the younger groups are moderating and possibly actually decreasing. This is very encouraging and we hope to see these trends continue, with the patterns among the younger continuing into the older age groups. Whether these moderations in rates reflect decreases in the prevalence of smoking, which have been greater among males than among females (13), or changes in the chemical composition of cigarettes, with decreases in the tar/nicotine content (14), is not known. Occupational exposures to carcinogens (12) may have diminished as workplace environments have improved. Nevertheless, the lung remains the leading primary site of cancer among men and is second only to colorectal cancer among both sexes combined (7). The geographic patterns of lung cancer incidence and the changes therein suggest areas that may be fruitful for further research.

Acknowledgments

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